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Ins A1

~~METHOD FOR ENCODING AND DECODING A DIGITALIZED IMAGE WITH PICTURE ELEMENTS~~

In image compression methods for encoding or~~, respectively~~, decoding digitized ~~digitalized~~ images, the images are usually divided into image segments.

A distinction is made between two approaches for image encoding, object-based image encoding and block-based image encoding. Object-based methods for image encoding are described in ~~[1].~~ Ins A2 An overview of block-based image encoding methods can be found in ~~[2] MPEG, [3] (H.263) and [4] (JPEG).~~ Ins A3

Given block-based image encoding methods, the image is divided into what are referred to as image blocks that usually comprise a rectangular shape and respectively comprise 8x8 or 16x16 picture elements. In the known methods, the blocks are transformed with the assistance of a transformation encoding, preferably discrete cosign transformation (DCT), wavelet transformation or a transformation with vector quantization.

Losses in the image quality must be accepted in the transmission of moving images over narrow-band channels such as, for example, 40 kbit/sec or lower for picture telephony applications. The most noticeable disturbances are the brightness discontinuities known as block artifacts in block-based image encoding or~~, respectively,~~ as object edge artifacts in object-based image encoding, i.e. the abrupt changes of the values of the encoding information that is allocated to the individual picture elements produced by discontinuity points at the image block edges or~~, respectively,~~ at the image object edges.

What is to be understood below by encoding information is, for example, luminance information or chrominance information that is respectively unambiguously allocated to the picture elements.

Two different approaches are known in order to reduce the block artifacts.

The first approach is based on corrections in the frequency domain of the spectral transformation. A method referred to as spatial shaping reduces the edge artifacts at the expense of the image quality in the interior of the block. This method

Ins A4 is known from ~~[5].~~ A4 Another method that is based on corrections in the frequency domain employs the prediction of the DCT coefficients. Although the quality in the interior of the block is improved by this procedure described in ~~[6],~~ a5 the block artifacts are only partially reduced. Ins A5

The second approach for reducing block artifacts is based on corrections in the location domain. ~~[7]~~ a6 discloses that the picture elements at the block edges be subjected to a low-pass filtering, as a result whereof the discontinuity points are smoothed and appear less disturbing. ~~[8]~~ a7 discloses that different filters be employed for different image blocks, dependent, for example, on the quantization of the image block or~~, respectively,~~ dependent on the motion vector. Ins A6 Ins A7

A A German Patent Application No. 19604050 ~~[9]~~ discloses a method for controlling various transmission parameters in the framework of the H.263 standard, which is referred to as J.245 standard. It is known within the framework of the H.245 standard to inform a second arrangement with which communication is desired of specific transmission properties from a first arrangement via what is referred to as a capability table wherein the respective feature that is to be employed within the framework of the communication connection is indicated.

SUMMARY OF THE INVENTION

Ins A8 A ~~The invention is based on the problem of specifying~~ a8 methods for encoding and for decoding a digitized ~~digitalized~~ image with which the required transmission capacity is reduced compared to known methods without the image quality being noticeably deteriorated.

Ins A9 A ~~The problem is solved by the methods according to patent claim 1, 2, 3.~~

A In an embodiment, the digitized ~~Given the method according to patent claim 1, the digitalized~~ image, which comprises picture elements, is divided into a number ~~plurality~~ of image segments. The division, i.e. the grouping, ensues such that at least one picture element is not allocated to an image segment for at least a part of the image between image segments. Only the picture elements that were allocated to an image segment are in fact encoded.

In an embodiment ~~Given the method according to patent claim 2;~~ an encoded image having picture elements that are allocated to image segments are decoded in that the image segments are decoded and new picture elements corresponding to non-encoded picture elements of the encoded image are inserted between the decoded image segments. An interpolation is implemented between the image segments, as a result whereof encoding information is allocated to the new picture elements.

In an embodiment, in a method ~~Given the method according to patent claim 3~~ for encoding and decoding of a digitized ~~digitalized~~ image, the picture elements are again grouped into a number ~~plurality~~ of image segments. The grouping ensues such that at least one picture element is not allocated to an image segment for at least a part of the image between image segments. Only the picture elements that were allocated to an image segment are encoded. The encoded image segments are transmitted and the image segments are decoded. New picture elements corresponding to the non-encoded picture elements of the encoded image are inserted between the decoded image segments. A filtering is undertaken between the image segments, as a result whereof encoding information is allocated to the new picture elements.

The invention can clearly be seen therein that the transmission of image lines and image columns between image segments, for example between image blocks is foregone in the present method. The block grid upon employment of a block-based image encoding method is spread such that interspaces remain between the image blocks to be encoded, and the interspaces are interpolated after the decoding.

As a result of this procedure, the required transmission capacity is reduced without the image quality in the interior of the image segment being noticeably deteriorated. Further, the block artifacts or~~, respectively,~~ the edge artifacts of the image objects are considerably reduced.

~~Advantageous improvements of the invention derive from the dependent claims.~~

In an embodiment, it ~~It~~ is advantageous to apply a low-pass filtering to the image segments as ~~filtering;~~ as a result whereof a good smoothing of the image segment edges is

achieved. It is thereby advantageous for saving required calculating time to implement the filtering essentially at the image segment edges.

In an embodiment, it ~~It~~ is also advantageous to implement a further filtering of the image to be encoded before the spreading and the encoding. The further filtering corresponds to a sub-sampling filtering as employed when sub-sampling images for improving the image quality.

In an embodiment, it ~~It~~ is also advantageous ~~in a development~~ to implement an interpolation filtering after the decoding, this taking effect essentially at the image segment edges. This corresponds to an over-sampling filter, as utilized when enlarging images.

In an embodiment, the ~~The~~ method can be very simply implemented given block-based image encoding methods wherein the image segments are image blocks. At least respectively one picture element is not allocated to an image block between the image blocks. A very simple division of the picture elements into the image blocks is thus achieved and, ~~and~~ connected therewith, a very simple selection of picture elements not to be encoded is achieved.

In an embodiment, in ~~In~~ order to further enhance the quality of the decoded image, it is advantageous to employ different filters for different image segments.

In an embodiment, it ~~It~~ is thereby advantageous to select the filters dependent on the image quality of an image block, whereby the strength of the filter employed increases with the reduction of the image quality of the image block.

In an embodiment, it ~~It~~ is also advantageous to select the different filters dependent on the motion vector of an image block, whereby the strength of the filter employed increases with the size of the motion vector that is allocated to the respective image block.

The method is very well-suited for utilization for image encoding according to the H.263 standard.

In an embodiment, an ~~An~~ advantageous possibility for integration of the present method into the H.263 standard is the employment of the capability table according to the H.245 standard, wherein the option for implementation of this method is entered as a separate

performance feature and becomes possible within the framework of the communication control that is implemented according to the H.245 standard.

Sub A10 ~~The figures describe an exemplary embodiment of the invention which is~~ explained in greater detail below.

Shown are:

Figure 1 through 1f the principle of the method for a symbolically presented digitalized image having image blocks;

Figure 2 an arrangement comprising a camera, two computer arrangements and two picture screens with which the method can be implemented;

Figure 3 a block circuit diagram with which the integration of the method into the ~~method according~~ to the H.263 standard is symbolically shown.

A Figure 2 shows a camera K that is connected to a first computer R1 via a connection V. The camera K supplies a sequence of digitized ~~digitalized~~ images B ~~that are supplied~~ to the first computer R1. The first computer R1, just like a second computer R2, comprises a processor P as well as a memory S for storing the image data that are connected to one another via a bus BU. The first computer R1 and the second computer R2 are connected to one another via a line L. The first computer R1 and the second computer R2 are respectively connected to a first picture screen BS1 or, ~~respectively,~~ to a second picture screen BS2 for the presentation of the images B registered by camera K and potentially encoded and decoded.

The camera K registers a scene and supplies it as a sequence of images B to the first computer R1, and this is encoded in the first computer R1 according to the method for encoding that is set forth below. The encoded images CB are transmitted via the line L to the second computer R2 and are decoded in the second computer R2 according to the method for decoding the encoded digital images CB that is set forth below.

A An image B is symbolically shown in Figure 1A ~~1a.~~ The image B in Figure 1a is subdivided into image blocks BB having respectively 8x8 picture elements BP. This is the standard procedure in block-based image encoding.

Figure 1B ~~1b~~ shows the image B with picture elements BP that are in turn grouped into image blocks BB each having respectively 8x8 picture elements BP. However, a respective interspace Z of at least one picture element BP is provided between the individual image blocks BB. The picture elements BP that are located in the interspace Z are not encoded, as explained below.

This obviously means that the picture elements BP of the interspaces Z are simply "omitted" in the encoding. By deleting the picture elements BP of the interspace Z, a reduced image grid BR of the image B arises that only comprises picture elements BP that were allocated to the image blocks BB (see Figure 1C ~~1c~~).

Arrows P of Figure 1B ~~1b~~ to Figure 1C ~~1c~~ symbolically show the imaging of the individual image blocks BB of the block grid with interspaces Z to the reduced image grid BR.

The encoding is implemented for the reduced image grid BR, i.e. only for the picture elements BP of the image blocks BB. This encoding ensues as transformation encoding according to discrete cosign transformation (DCT).

The method according to the H.263 standard is utilized as an encoding method. The encoded image data CB are transmitted to the second computer R2, received thereat and decoded (See Fig. 1D) ~~(Step 101; see Figure 1d).~~

After the decoding, potentially upon employment of inverse discrete cosign transformation according to the H.263 method, a decoded, reduced image grid DBR derives that corresponds to the reduced image grid BB ~~RB~~ (see Figure 1E ~~1e~~).

The decoded, reduced image grid DBR is now expanded onto an expanded image grid EBR having the original size of the image B, in that the interspaces Z with the non-encoded picture elements are in turn filled between the image blocks BB (see Figure 1F ~~1f~~).

Image blocks BB that, due to the interspaces Z, lie at the image edge BRA and do not comprise 8x8 picture elements are processed by padding, i.e. filling up the image blocks BB with encoding information by extrapolation of the picture elements BP in fact present in the image block BB. The filling can ensue by allocation of the

encoding information of the picture elements BP that were previously not contained in the image block of the image edge BRA with a constant value.

The relationships of the decoded image blocks BB in the decoded, reduced block grid BR from Figure 1E ~~1e~~ and the image blocks BB in 1F ~~1f~~ after insertion of the interspaces Z are shown by arrows P in Figure 1E ~~1e~~ and 1F ~~1f~~.

New picture elements are inserted into the decoded, reduced block grid DBR between the decoded image segments, i.e. the image blocks BB, being inserted in conformity with the non-encoded, i.e. "omitted" picture elements BP of the encoded image.

In a last step, an interpolation filtering between the individual image blocks BB across the block edges and across the interspaces Z, i.e. over the picture elements of the interspaces Z, is implemented in the expanded image grid EBR. An interpolation of the "missing" picture elements is thus achieved.

A low-pass filtering at the block edges is implemented as filtering. A number ~~plurality~~ of filters for different image blocks is selected according to the semantics of the individual image blocks BB. The selection of the filters ensues dependent on the motion vector of an image block, whereby the strength of the low-pass filter employed increases with the size of the motion vector and/or dependent on the image quality of an image block, whereby the strength of the low-pass filter employed increases with the reduction in image quality of the image block BB.

~~Versions of the exemplary embodiment set forth above are disclosed blow.~~

It is not necessary to divide the image B into image blocks BB. It is likewise possible to utilize an object-based image encoding method within the scope of the inventive method, whereby the picture elements BP are then grouped into a number ~~plurality~~ of image segments having an arbitrary shape.

Further, any desired object-based or~~, respectively,~~ block-based image encoding method, for example MPEG, JPEG, H.263 can be utilized, as can any desired transformation encoding, for example discrete sine transformation, a wavelet transformation or a transformation on the basis of vector quantization.

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Figure 3 also symbolically shows an embodiment ~~a possibility~~ of how the method can be integrated into the existing H.263 standard. To this end, the mechanism of what is referred to as the capability table CT according to the H.245 standard is utilized (see Figure 3). A selection as to whether the standard H.263 method or the method for image encoding expanded by the inventive method should be employed can be made via a switch element SE.

The expansion is symbolically shown by a block E in Figure 3. When the expansion is selected, then a corresponding parameter is stored in the capability table CT in the first computer arrangement R1, and is proposed in the framework of the setup of the communication connection to the second computer unit R2, which likewise comprises modules for the implementation of the H.245 standard and of the H.263 standard and of the expansion module E.

After agreement about the image encoding method to be employed has been reached between the computer arrangements R1, R2, either the method according to H.263 or the method expanded by the inventive method is employed.

The invention can clearly be seen therein that the transmission of image lines and image columns between image segments, for example between image blocks, is foregone in the method. The block grid given employment of a block-based image encoding method is spread such that interspaces remain between the image blocks to be encoded and the interspaces are interpolated after the decoding.

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